

This study quantifies and contrasts the vaccination effort required to arrest the propagation of an online meme whose b
Introduction Viral information—memes, rumours, or misinformation—can disseminate rapidly across online social platf
Methodology Network Construction Because only aggregate degree statistics are provided, a configuration model [0] wa

A 10^4 -node degree sequence sampled from this bi-modal distribution was realised (Python script `network_construction.py`
Epidemic Model A standard SIR process was implemented using the FastGEMF simulator. Edge-based infection at rat
Vaccination Scenarios Random immunisation A fraction f of nodes is selected uniformly at random and moved to the r
Simulation Protocol For each scenario five stochastic realisations were executed up to $t = 300$. Script `simulation_11.1`
Analytical Results Random Vaccination Threshold Under heterogeneous mean-field theory [0], the epidemic threshold ϕ

Vaccinating three quarters of the population at random is therefore sufficient.

Degree-Targeted Threshold Let f denote the *fraction of degree-10 nodes* vaccinated. After removal, the residual mome
 $\langle k^2 \rangle_{res} = \frac{100p_{10}(1-f)+4(1-p_{10})}{1-p_{10}f}$, which yield

Setting $q_{res} = 1$ and solving gives $f_c = 1$. Consequently

Notably, although this is the entire high-degree subset, the global coverage is markedly lower than random vaccination.

Simulation Results Key epidemic metrics averaged over the five stochastic runs are summarised in Table . Vaccinated i

	Strategy	Peak prevalence (%)	Peak time	Final attack (%)
[t] Simulation outcomes. Population size $N = 10\,000$.	Random (75%)	0.14	1.11	0.28
	Degree 10 (12.5%)	0.13	4.47	1.42

Figures and depict the temporal compartment trajectories for a representative realisation.

[http] [width=0.85]results-11.png Population dynamics under 75 % random vaccination. Infection fails to sustain and d

[http] [width=0.85]results-12.png Population dynamics when all degree-10 nodes are vaccinated. A minor outbreak occ

Discussion Analytical thresholds aligned closely with stochastic simulation. Random vaccination at $p_c = 75\%$ essentially

These findings corroborate earlier theoretical work showing the superiority of degree-based strategies when node degree

Limitations include the simplified two-point degree distribution, absence of clustering, and perfect vaccine assumption.

Conclusion The study demonstrates that for a meme with $\mathcal{R}_0 = 4$ on an uncorrelated network of mean degree 3, immu

*Acknowledgement The computational experiments utilised the FastGEMF library.

9

L. Gallos, F. Liljeros, P. Argyrakis, A. Vespignani and S. Havlin, “Improving immunization strategies,” *Phys. Rev. E*, vol. 7

M. Zhou, W. M. Xiong, H. Liao and X. Wang, “Analytical connection between thresholds and immunization strategies of S

R. M. Anderson and R. M. May, *Infectious Diseases of Humans*, Oxford Univ. Press, 1992.

R. Pastor-Satorras, C. Castellano, P. Van Mieghem and A. Vespignani, “Epidemic processes in complex networks,” *Rev. M*

M. E. J. Newman, S. H. Strogatz and D. J. Watts, “Random graphs with arbitrary degree distributions and their applicatio

Code Availability All Python scripts and data files generated during this work are located in the `output` directory:

`network_construction.py`

`network.npz`

`simulation_11.12.py`

`results-11.csv, results-11.png`

`results-12.csv, results-12.png`

`analysis_metrics.py`